

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Modification of Parts 2 and 15 of the	)	ET Docket No. 03-201
Commission's Rules for unlicensed devices and	)	
equipment approval.	)	
	)	
	)	

**Via the ECFS**

**COMMENTS OF IEEE 802**

1. IEEE 802<sup>1</sup> respectfully offers its Comments on the Notice of Proposed Rulemaking (the "NPRM") in the above-captioned Proceeding.<sup>2</sup>
2. IEEE 802, as a leading consensus-based industry standards body, produces standards for wireless networking devices, including wireless local area networks ("WLANs"), wireless personal area networks ("WPANs"), and wireless metropolitan area networks ("Wireless MANs").
3. The members of IEEE 802 that participate in the IEEE 802 standards process are interested parties in this proceeding.
4. IEEE 802 appreciates the opportunity to provide these comments to the Commission.

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<sup>1</sup> The IEEE Local and Metropolitan Area Networks Standards Committee ("IEEE 802" or the "LMSC")

<sup>2</sup> This document represents the views of IEEE 802. It does not necessarily represent the views of the IEEE as a whole or the IEEE Standards Association as a whole.

**IEEE 802 SUPPORTS THE COMMISSION’S ACTIONS IN THE SUBJECT NPRM TO  
INTRODUCE ADDITIONAL FLEXIBILITY AND CONSISTENCY IN THE RULES  
FOR PART 15 DEVICES.**

5. In our comments, we will address each of the Commission’s proposed changes in accordance with the general outline in the introduction to the NPRM, where the Commission states:

*“Specifically, in this Notice, we propose to: 1) modify the rules to permit the use of advanced antenna technologies with spread spectrum devices in the 2.4 GHz band; 2) modify the replacement antenna restriction for Part 15 devices; 3) modify the equipment authorization procedures to provide more flexibility to configure transmission systems without the need to obtain separate authorization for every combination of system components; 4) harmonize the measurement procedures for digital modulation systems authorized pursuant to Section 15.247 of the rules with those for similar U-NII devices authorized under Sections 15.401- 15.407 of the rules; 5) modify the channel spacing requirements for frequency hopping spread spectrum devices in the 2.4 GHz band in order to remove barriers to the introduction of new technology that uses wider bandwidths; 6) clarify the equipment authorization requirements for modular transmitters; and 7) make other changes to update or correct Parts 2 and 15 of our rules. In addition, we invite comment on ways the Commission might improve spectrum sharing among unlicensed devices.”<sup>3</sup>*

**IEEE 802 SEES THE NEED FOR A BALANCED APPROACH TO SECTORIZED  
ANTENNA RULES**

6. In changing these rules the FCC must be careful not to set limits based on today’s technologies that may restrict future technology developments, and that there is a clear understanding of the benefits and issues with the current technologies. Although both sectorized and/or phased array systems can provide important benefits, solutions allowed by the rules must not be detrimental to other wireless communication devices or future developments.

7. In section 11 of the NPRM, the Commission asks: *“We seek comment regarding the characteristics that a system would need to exhibit in order to be classified as a sectorized or phased array antenna system.”*

8. IEEE 802 believes that that classification should be broadened to include future developments (MIMO, space/time codes, etc.).

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<sup>3</sup> ET Docket No. 03-201, paragraph 1

**IEEE 802 RECOMMENDS THAT THE COMMISSION CONSIDER A WIDER TOTAL BEAMWIDTH**

9. Why is 120 degrees aggregate a limit? We see no reason why the total beam width should be limited to 120°. The aim of paragraph 11 appears to disallow systems exploiting the total EIRP and building high power omni-directional devices, however the rule as stated does not accomplish this, i.e. it does not prohibit the use of 120, very high power beams, which is equally as detrimental.

10. The proposed 120° degree rule makes it particularly difficult for wireless providers as it can increase their costs significantly. One of the largest costs of wireless service is installation and site licensing fees. Systems disallowed by this wording could provide full 360° coverage from a single device installation, greatly reducing deployment and operating costs.

**IEEE 802 RECOMMENDS USING ANTENNA PATTERN AS THE BASIS FOR EVALUATING THE EQUIVALENCE OF REPLACEMENT ANTENNAS RATHER THAN THE PHYSICAL CONFIGURATION OF THE ANTENNA.**

11. The NPRM states:

*“Any antenna of a similar type that does not exceed the antenna gain of tested antennas may be used without retesting. Use of an antenna of a different type than the tested antenna (i.e. yagi antenna vs. a horn antenna) or one that exceeds the gain of a tested antenna would require retesting and new approval by either a Telecommunication Certification Body or the Commission.”<sup>4</sup>*

12. IEEE seeks clarification on the use of the term antenna “TYPE” in reference to proposed changes to FCC section 15.203. The NPRM is focused on Access Point considerations while client side radios are affected by the same rules.

13. In the client radio industry the term antenna “TYPE” can be interpreted by a Telecommunication Certification Body (“TCB”) as a different material make up and not necessarily a different antenna pattern as alluded to in this section.

14. IEEE 802 recommends using antenna pattern as the basis for evaluating the equivalence of replacement antennas rather than the physical configuration of the antenna. This evaluation method would address both the Access Point and Client market for antenna rules.

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<sup>4</sup> ET Docket No. 03-201, paragraph Appendix A, paragraph 12

## **IEEE 802 SUPPORTS HARMONIZED RULES FOR POWER MEASUREMENT**

15. We fully support the Commission's efforts to simplify and harmonize the rules for power measurement as applied to digital modulations. We note that the Commission, in the proposed draft text for Part 15 rules in 15.247(e) re: peak power measurement states:

*"The peak output power and peak power spectral density for digitally modulated system may be determined in accordance with the provisions specified in §§ 15.407(a)(4) and 15.407(a)(5)."*<sup>5</sup>

As currently written, the two referenced paragraphs do not clearly spell out measurement procedures for peak power measurement.

## **IEEE 802 RECOMMENDS THAT THE PROCEDURAL CLARIFICATIONS GIVEN BY THE COMMISSION IN DA-02-2138 BE INCLUDED IN THE NEW RULES ON PEAK POWER MEASUREMENT**

16. The Commission previously felt the need to clarify the U-NII power measurement rules beyond the texts in 15.407(a)(4) and 15.407(a)(5) by issuing DA-02-2138, "*Measurement Procedure Updated for Peak Transmit Power in the Unlicensed National Information Infrastructure (U-NII) Bands*", which provides considerable clarification as to the intent of the U-NII band power specifications and the approved measurement methods. For example, DA-02-2138 states

*"To accommodate this new technology [specifically, multi-carrier modulation in DA-02-2138, or, as it has evolved, digital modulation in the current 15.247 rules] peak transmit power may be averaged across symbols over an interval of time equal to the transmission pulse duration of the device or over successive pulses. The averaging must include only time intervals during which the transmitter is operating at its maximum power level and must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level."*

*"Appendix A describes acceptable measurement procedures under this interpretation. Though not required, provision of a continuous transmit mode on devices to be tested will simplify the measurement process."*<sup>6</sup>

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<sup>5</sup> ET Docket No. 03-201, paragraph 1

<sup>6</sup> DA-02-2138A1, August 30, 2002, page 1.

17. It seems to us that the clarifications in DA-02-2138 are still necessary to support the Commission's intent in this NPRM to implement consistent rules for power measurement in the case of digital modulations. We strongly recommend that the Commission include the substance of the measurement techniques specified in DA-02-2138 within the planned update to Part 15 rules either explicitly in an appropriate section of the rules, or by reference to DA-02-2138 to fully clarify the complex issue of power measurement.

### **IEEE 802 SUPPORTS THE CHANGE IN HOPPING RULES TO ACCOMMODATE THE PROPOSED NEW BLUETOOTH MODULATIONS**

18. We understand from the Commission's comments that the Commission proposes to limit this modification to the 2.4 GHz segment in response to the specific change requested by the Bluetooth SIG. We recommend that the Commission adopt this new rule for the following reasons:

- A. The 2/3 bandwidth rule increases the number of frequency hopping channels in that can fit into available spectrum for a given 20 dB transmission bandwidth, improving the opportunity for frequency hopping systems to adaptively avoid interfering signals from other systems.
- B. Frequency hopping systems using spread spectrum techniques to improve performance in the presences of interference will pay a smaller penalty in terms of the number of available channels compared to the present rules. For example, FSK systems might use a higher than optimum modulation index to reduce their sensitivity to interference from co-channel and intermodulation induced interference, and at the same time have more hopping channels in available under the 2/3 bandwidth rule compared to the present rules.

### **IEEE 802 RECOMMENDS ALLOWING THE 2/3 RULE FOR ALL FREQUENCY HOPPING SYSTEMS REGARDLESS OF THE NUMBER OF HOPPING CHANNELS**

19. We recommend that the 2/3 bandwidth rule apply to all frequency hopping systems in the 2.4 GHz band operating at an output power no greater than 125 mW, regardless of the number of hopping channels employed, as opposed to the limitations stated in the proposed changes to Part 15.247. The net effect of the 2/3 bandwidth rule is to increase the number of available hopping channels, improving the interference immunity of any frequency hopping implementation. We believe that restricting the rule to systems operating with less than 75 hopping channels denies the benefits of the 2/3 rule to a wider range of systems without any clear benefit to coexistence between different systems.

**IEEE 802 RECOMMENDS THAT MODULAR APPROVAL BE EXTENDED TO  
ALLOW TRUE MIX-AND-MATCH COMBINATION OF MODULAR COMPONENTS**

20. The concept of modularity put forth by the Commission, namely:

*“These transmitters consist of two basic components: the “radio front end,” or radio elements and the “firmware” or specific hardware on which the software that controls the radio operation resides. The radio front end and firmware can each be self-contained units.”<sup>7</sup>*

as stated freezes two “sets of behavior”, radio behavior and firmware behavior, and welds them together in terms of compliance requirements. The benefit of the rule seems to be limited to a manufacturer of both sets, or to cooperating manufacturers of these sets. The digital key recognition concept, taken to its logical limits, could allow module interfaces to be defined at a variety of alternative boundaries. This implementation flexibility will encourage technological innovation and allow competitive development to take place, something that is de-facto prevented by the current wording of the requirement.

**IEEE 802 SUPPORTS THE DIGITAL KEY RECOGNITION APPROACH TO  
ENSURING ONLY CERTIFIED COMBINATIONS OF MODULAR COMPONENTS  
ARE FUNCTIONAL**

21. In principle, the proposed requirement would facilitate the broader form of modularity advocated in our previous comment. In fact it can be generalized so that an intelligent device that controls the behavior of a radio subsystem can verify that the types of all the modules involved – including the antenna in some case – are all acceptable for the regulation under which it is supposed to operate.

22. Concerning the Type Number and its encryption we suggest that such a type number be sealed with the supplier’s secret key (of a public key crypto system) to form an originator’s certificate. The processes for generating such keys and signatures are a well established.

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<sup>7</sup> ET Docket No. 03-201, paragraph 33

## **IEEE 802 NOTES THAT SPECTRUM ETIQUETTE REGULATIONS HAVE NOT ALWAYS ACCOMPLISHED THE INTENDED PURPOSES**

23. Previous attempts at imposing spectrum etiquettes have a checkered history, not in the least because the concept is simple and therefore attractive but the realization is difficult – even for a specific class of devices. A case in point is unlicensed PCS – development of the etiquette took a long time and its success in the market to date is questionable. The latter is not true of the “Wi-Fi” standards developed by IEEE 802.11. Here very specific spectrum sharing methods have been developed to meet market demands. As the requirement to provide more performance and quality of service increased, the complexity of the spectrum sharing mechanisms increased as well. Again, this complexity proves necessary even within the context of a single type of a single family of devices.

24. Whether an etiquette is needed at all depends very much on the relative distances and duty cycles of the equipment concerned. More work on understanding the need for and the utility of etiquettes for spectrum sharing is required.

25. At least two forms of etiquette may be distinguished – the in-band signaling etiquette and the out of band signaling etiquette. Both allow a variety of devices to share spectrum but differ in their operation and cost.

26. An in-band signaling etiquette uses the same frequency channel to communicate sharing information. It uses the same radio transceiver as is used for data communications. In the most simple form that information is simply binary information about spectrum occupation at some point in time – the simple listen-before-talk etiquette. Because spectrum access has to be extremely conservative in order to avoid devices obliterating each other’s transmissions, such a simple etiquette is inefficient and a hindrance to the full performance of the devices that use it. The barriers to such an etiquette will be greater with the increasing differences in spectral behavior of the devices concerned and the degree of tolerance they have for interference. For example, if one were to derive an etiquette from the specifications of WiFi and WiMax systems so as to allow the two to share the same spectrum, the result would be inefficient and complex.

27. An out of band signaling etiquette may require two transceivers – one for the signaling channel and one for the data transmission channel. Using a single transceiver is possible but less efficient since signaling and data transmissions compete for the same resource. With two transceivers, devices can continually communicate about their use of and requirements for use of the shared spectrum and so optimize the use of the available spectrum. Also, the data transmission “band” can be much broader than the signaling band – this is another advantage of an out of band signaling etiquette that in some cases may be considered to offset its cost of implementation.

28. The above few paragraphs only touch upon the complexity of the issue of etiquettes for spectrum sharing. Therefore, we suggest that the Commission, instead of mandating an etiquette at an early stage, work together with industry and academia to investigate the technical and practical possibilities before issuing regulation in this matter.

**IEEE 802 BELIEVES THAT SPECTRUM SHARING CAN BE ACCOMPLISHED BY A  
VARIETY OF APPROACHES**

29. The issues related to spectrum sharing are complex, as the Commission clearly indicates by the lengthy list of questions the Commission poses in this NPRM regarding spectrum etiquette.

30. In the most general sense, sharing of spectrum between heterogeneous networks operating under Part 15, or sharing between unlicensed devices and licensed services like broadcast TV, or sharing between unlicensed devices and equipment and systems that have primary allocations for national security reasons can be accomplished by human agency (contracts, or agreements between various parties to cooperate in sharing spectrum), by government regulation, and/or by technologies which promote shared access.

**IEEE 802 RECOMMENDS NO CHANGE TO PART 15 RULES FOR CURRENTLY  
ALLOCATED SPECTRUM TO ADD ADDITIONAL SPECTRUM ETIQUETTE  
REQUIREMENTS**

31. Within the currently established Part 15 bands, with the exception of the U-NII band compromises, and the current rules for the unlicensed PCS band, adding more rules regulating spectrum etiquette than those which exist or which are in process (i.e. the 5 GHz NPRM) seems to us to be unnecessary.

**IEEE 802 SUPPORTS DEFINING SPECTRUM ETIQUETTE WHICH WOULD  
ENABLE UNLICENSED SHARING OF LICENSED BANDS, ESPECIALLY UNUSED  
TV BROADCAST CHANNELS**

32. From a technology standpoint, proceeding from concepts established by the Unlicensed PCS etiquette, the DFS and TPC protocols put in place as part of the agreements for adding spectrum to the 5 GHz U-NII band, and the general practices developed by IEEE 802 in creating standards which establish the operating characteristics of wireless networks, it is possible to envision a set of protocols which would support effective sharing between licensed and unlicensed services operating in the same bands.

33. Protocols required for sharing of spectrum between unlicensed networks and licensed or incumbent networks need as a minimum to support autonomous operation, collision avoidance, and frequency reuse. These protocols could be described as the operational basis for the spectrum etiquette for unlicensed cognitive radio systems operating in the presence of incumbent users on a non-interference basis.



34. A minimum set of protocols to support a fully cognitive spectrum etiquette might be described as follows:

- Network Frequency Allocation (NFA), which provides a mechanism to make and change network frequency assignments on an adaptive basis to avoid incumbents (TV broadcasters or other services with regulatory priority over unlicensed devices), and to select preferentially either unused or lightly used operating channels.
- Link Power Control (LPC), which allows the receiver at the terminal node of a two node link to tell the transmitter at the source node how to minimize its output power while still maintaining good overall network performance. The goal is to reduce the aggregate power emitted by the network to make the network's operating frequency available for reliable operation by other networks located nearby.
- Incumbent Profile Detection (IPD), which supports licensed user detection based on some reliable spectrum signature. In sharing between TV broadcast services and an unlicensed network as an example, the IPD implementation might identify an NTSC broadcast by detecting the sound subcarrier, or identify an ATSC broadcast by detecting the pilot tone in the ATSC spectrum.
- Collision Detection And Avoidance (CDAA), which implements a "listen-before-talk" etiquette along with an appropriate backoff and retry timing mechanism when a collision occurs during a transmission. Burst mode communications methods are the only way to share a channel among heterogeneous unlicensed devices, or among nodes on a single network. Since collisions are inevitable, some means has to be provided to deal with a collision.

**IEEE 802 URGES THE COMMISSION TO MOVE AHEAD WITH RULEMAKING  
WHICH WOULD SUPPORT UNLICENSED USE OF UNOCCUPIED BROADCAST TV  
CHANNELS**

35. In terms of unlicensed sharing with licensed services, including the possibility of harvesting fallow TV broadcast spectrum, it seems to us the cognitive protocols described above provide the basis for a robust spectrum etiquette which fully protects the interests of incumbent broadcasters.

36. We urge the Commission to move ahead with rulemaking which would allow unlicensed systems to operate in otherwise fallow TV broadcast spectrum. Such rules would improve spectrum efficiency and create opportunities for commercial and non-profit utilization of what is currently a largely wasted national asset.

**IEEE 802 SUPPORTS HP'S REQUEST FOR AN INCREASE IN THE NUMBER OF  
UNITS THAT MAY BE IMPORTED FOR EVALUATION**

37. We support HP in suggesting that the limits on the number of units that can be imported for test and evaluation purposes be increased to 2000, and that the quantity of devices allowed for demonstrations be increased to 100. It seems reasonable to allow the use of demonstration equipment for market development activities outside of trade shows. We also support simplifying the FCC's rules by combining Sections 2.1204(a)(3) and 2.1204(a)(4).

Respectfully submitted,

/s/

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